

CRUISE REPORT: Repeat Hydrography on Line PR6:
WOCE Cruise No. 18DD9601/1

Chief Scientist: Frank Whitney
Ship: John P. Tully
Ports of Call: none
Cruise Dates: February 19 to March 8, 1996
Expedition Designation: 18DD9601/1

Cruise Narrative

Our repeat hydrography section continues to be a joint program with Canadian JGOFS.

A CTD survey along Line PR6 was completed, except for 2 stations which were omitted due to weather. Salinity, oxygen and nutrients (NO₃ & NO₂, PO₄ and Si) were analyzed onboard ship from rosette casts at 4 stations. DMS was analyzed in sea water, to a depth of 400 m.

A profiling Alace float (T/S/P), ballasted to rest at 800 m, was deployed near station PRS1 (Ocean Station Papa). Near the current location of an Alace float that was launched in September 1995, we took a CTD cast to check for sensor drift.

JGOFS participants collected samples for biomass estimates at 4 stations, and incubated water to measure growth and grazing rates of various groups of plankton. A large volume in situ pumping system (J. Bishop) was successfully deployed only at station PRS1.

Cruise Summary Information

Cruise track

Line PR6 starts at the mouth of Juan de Fuca Strait on the west coast of Canada, and heads almost due west for 900 n mi. The terminal station is PRS1, formerly designated Ocean Weather Station Papa (50 N, 145 W).

Table of Stations by type

| Sample type: | No. stations: | Max. depth (m): |
|-----------------------|---------------|-----------------|
| CTD casts | 27 | 4300 db |
| Rosette/Hydro casts | 4 | 4200 |
| Loop samples | 31 | 5 |
| Profiling Alace float | 1 | 800 |
| Surface drifters | 2 | 20 |

Floats and Drifters deployed

A profiling Alace float was deployed at station PRS1. Surface drifters that collect temperature and barometric pressure data were deployed at stations P20 and PRS1 for the Department of the Environment.

Principal Investigators

| | | |
|-----------------|-------------------|-----|
| Howard Freeland | Ocean circulation | IOS |
| C.S. Wong | Climate chemistry | IOS |

Frank Whitney
Philip Boyd

WOCE coordinator
JGOFS coordinator

IOS
UBC

Preliminary Results

Typical winter conditions were encountered along Line PR6. Optical measurements indicate that biomass in the surface was higher at PRS1 than nearer the coast. A current meter positioned deep in the mixed layer at PRS1 recorded the breakdown of the summer thermocline in mid-October. Temperature abruptly increased as heat was mixed into the surface layer.

Goals Achieved

CTD survey of Line PR6, minus 2 stations .
Successful Rosette casts at 4 stations on Line P.
Completion of JGOFS sampling for plankton and productivity measurements.
One large volume pump station at PRS1 for particulates.
A mooring with an optical package and S4 current meter, both in the mixed layer, was recovered and redeployed.

Problems and Goals not Achieved

Less water sampling and pumping was completed than had been planned, due to poor weather.
A ground fault limited the work completed with the pumping system.
The optical instrument on the mooring failed. No useful data was recovered from it.

Cruise Participants & Affiliations

| | | |
|------------------|---|-------------|
| Frank Whitney | Nutrients, watch | IOS |
| Bernard Minkley | Oxygen, watch | IOS |
| Nick Hall-Patch | Salts, watch | IOS |
| Wendy Richardson | DMS, watch | IOS |
| Tim Soutar | Watch, pCO ₂ | IOS |
| Ron Bellegay | Watch, carbonates | IOS |
| Philip Boyd | Phytoplankton | UBC |
| Robert Goldblatt | Zooplankton biomass | UBC |
| Hugh Maclean | Watch, plankton sampling | UBC |
| Nelson Sherry | Bacteria | UBC |
| Maureen Soon | particulate ¹³ C & ¹⁵ N | UBC |
| Suzanne Roy | Zooplankton excretion | Rimouski U. |
| Ken Crocker | Zooplankton grazing | Memorial U. |
| Jennifer Putland | Micro-zooplankton | Memorial U. |
| Jim Bishop | pump sampling | U. Victoria |
| Todd Mudge | pump sampling | U. Victoria |
| Stacey Cooper | pump sampling | U. Victoria |

IOS = Institute of Ocean Sciences, Sidney, B.C., Canada.

UBC = University of British Columbia, Vancouver, B.C., Canada

Measurement Techniques and Calibrations

CTD profiles

At all stations, a Guildline 8705 CTD coupled with a transmissometer was lowered to a maximum of 1500 m.

Water sampling

A rosette holding a Guildline 8737 CTD and 23-10 L polycarbonate Niskin bottles was used for most water sampling. Go-Flo bottles clamped on Kevlar hydro line were used to collect clean water for plankton studies.

At each station, samples for surface chlorophyll, salinity and nutrients were collected from the ship's sea water loop which pumps water from about 5 m continuously into the laboratory.

Salinity

Samples were collected in glass bottles and analyzed onboard ship using a Guildline Model 8410 Portasal. The Portasal was standardized daily with IAPSO standard sea water Batch P128.

Oxygen

An automated titration system (Brinkman Dosimat and Fiber Optic Probe Colorimeter) using the micro-Winkler method (Carpenter, 1965), titrated samples to the iodine end-point. Standards were prepared as outlined in WOCE Report 73/91.

Nutrients

Samples from hydro casts were collected in polystyrene tubes and refrigerated for a maximum of 12 h before being analyzed. Loop samples (USW) were stored up to 2 days at 4°C before being analyzed. NO₃+NO₂, PO₄ and Si were analyzed using a Technicon Autoanalyzer.

NO₃+NO₂ samples were reduced with Cd/Cu, then complexed with sulfanilamide and N-Naphthylethylene-diamine to form an azo dye (Technicon Method No. 158-71W/B). PO₄ produces a molybdenum blue complex in presence of acidic molybdate and ascorbic acid (Technicon Method No. 155-71W). Dissolved Si also forms a molybdenum blue complex and oxalic acid removes PO₄ interference (Technicon Method 186-72W).

Concentrated standards were freshly prepared the week before the cruise from oven dried reagents. Working standards were made every 1 to 2 days by diluting 1 to 6 mL of various stock solutions to 250 mL with 3.2% NaCl (w/v in double run Milli-Q water). Standards were checked against Acculute Standards (Anachemia Science) with good agreement (peak heights agreed to within 1%).

Table. Laboratory temperatures for nutrients and salinity.

| date | temp (C) | date | temp (C) |
|--------|-------------|--------|-------------|
| Feb 21 | 24.1 - 24.5 | Feb 23 | 23.0 - 23.5 |
| Feb 26 | 20.8 - 21.1 | Feb 29 | 21.8 - 22.2 |
| Mar 2 | 23.4 - 23.9 | Mar 6 | 22.6 - 22.7 |

TCO₂, ¹³C and Alkalinity - a single profile was collected at PRS1. Samples were fixed with HgCl₂ and refrigerated.

O18/O16 - samples were collected in 60 mL polyethylene bottles and refrigerated.

JGOFS sampling - Go-flo bottles were used to collect water for POC/N, DOC/N, chlorophyll, nano- and micro-plankton and incubation experiments. At PRS1, an *in situ* drifter was deployed for 7 h to measure primary production rates. Deck incubations were conducted to measure growth rates of bacteria, phytoplankton and micro-zooplankton.

References

Carpenter, J.H. 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. *Limnol. Oceanogr.*, **10**: 141-143.

Technicon Industrial Method No. 155-71W. 1973. Orthophosphate in water and seawater.

Technicon Industrial Method No. 158-71W/A. 1977. Nitrate and nitrite in water and seawater.

Technicon Industrial Method No. 186-72W/B. 1977. Silicates in water and seawater.

WOCE Report 73/91. 1991. A comparison of methods for the determination of dissolved oxygen in seawater.